Spruce

White spruce, *Picea glauca*
Black spruce, *Picea mariana*

The **volume of spruce has increased** significantly since 1983. The number of seedlings has doubled in the last ten years suggesting that, unless mortality increases significantly, the spruce resource will remain stable in the future.

Mortality rates, however, **are higher than average**. Whereas spruce makes up about 2% of volume and growth of trees in Wisconsin, it accounts for 3% of total mortality.

Spruce is **not an important timber species**, accounting for only 1% of roundwood product and 1.7% of woody biomass. It is a low density wood and may not be good for biofuel production.

- *How has the spruce resource changed?*
  Growing stock volume and diameter class distribution: 1983, 1996, and 2008
- *Where is the spruce resource in the state?*
  Growing stock volume by region with map
- *How fast is spruce growing?*
  Average annual net growth by region and year: 1983, 1996, and 2008
- *How healthy is spruce in Wisconsin?*
  Average annual mortality: 1983, 1996, and 2008
- *How much spruce do we harvest?*
  Roundwood production by product and year: 1997, 2003, and 2006
- *How much is spruce selling for?*
  Prices for cordwood and sawtimber: 2000 to present
- *How much spruce biomass do we have?*
  Oven-dry tons by region of the state: 2008

"How has the spruce resource changed?"

Growing stock volume and diameter class distribution by year

The growing stock volume of spruce in Wisconsin in 2008 was approximately 447 million cft or about 2% of total statewide volume (Chart 1). This represents an increase of 38% since 1983 and 11% since 1996.

The spruce resource is maturing. Volume in all size classes has increased but especially in larger trees (Chart 2). For instance, the volume in small trees (5 to 13 inches) has increased 24% since 1983 but the volume in large trees (over 13 inches) has more than doubled in the same period.

The number of seedlings has doubled in the last ten years (Chart 3), suggesting that spruce will remain a vital component of our forests in the future.

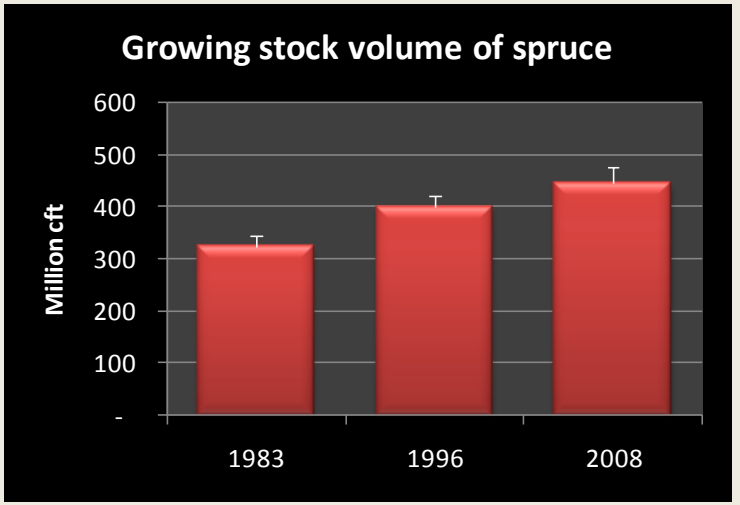


Chart 1. Growing stock volume (million cubic feet) by inventory year.
Source: USDA Forest Inventory and Analysis data: 1983, 1996, and 2008.

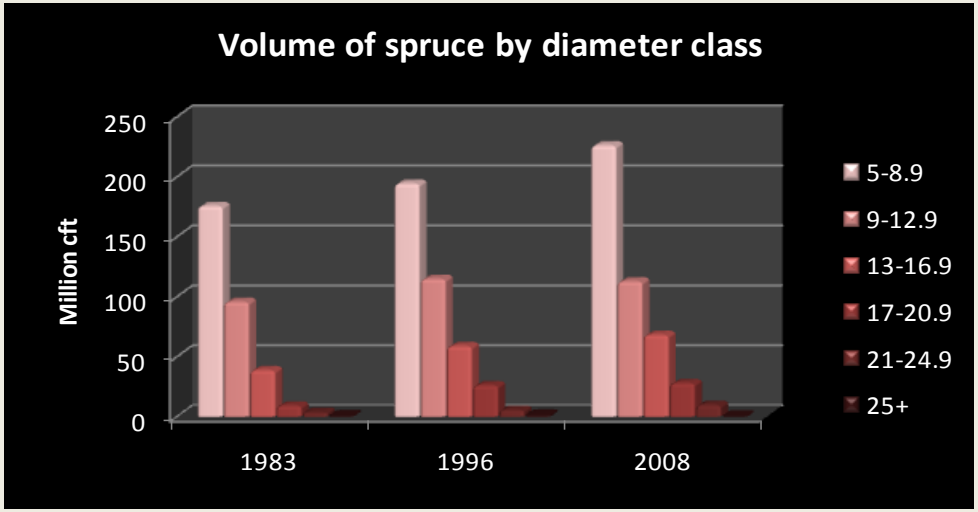


Chart 2. Growing stock volume (million cubic feet) in 1983, 1996, and 2008.
Source: USDA Forest Inventory and Analysis data: 1983, 1996, and 2008.

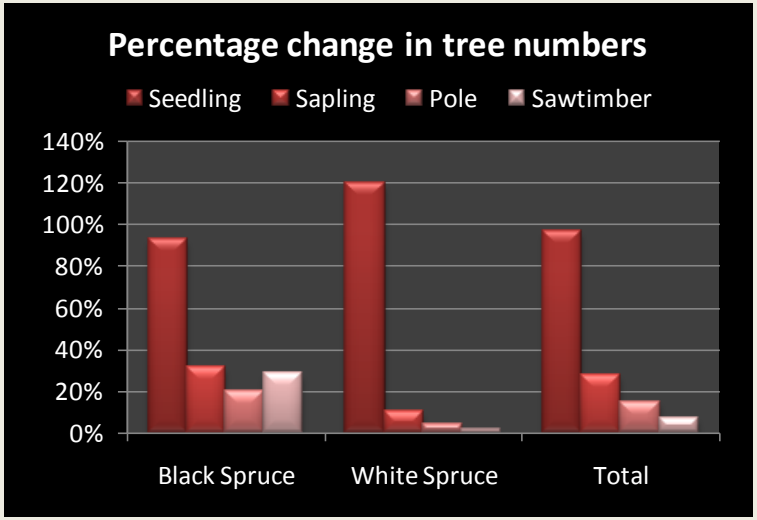
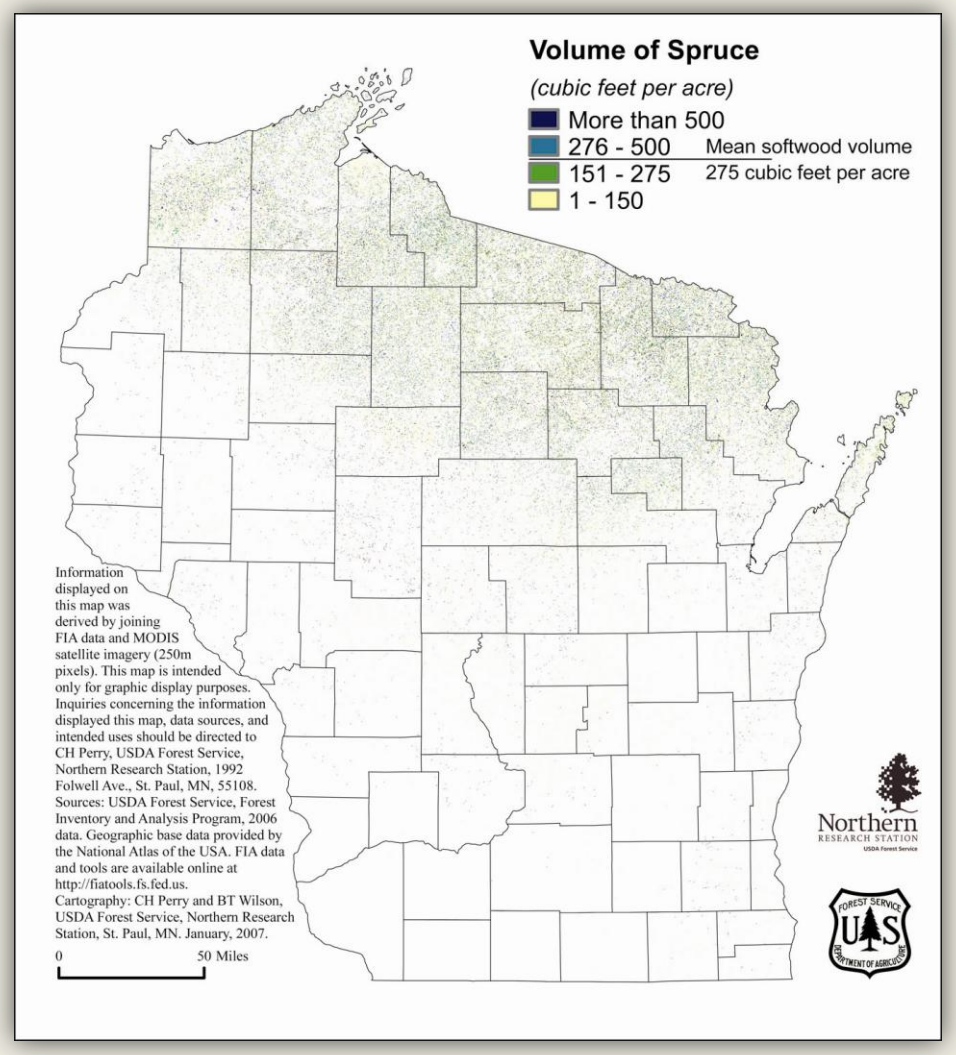


Chart 3. Percentage change in the number of live trees by size class between 1996 and 2008.
Source: USDA Forest Inventory and Analysis data 1996, and 2008.

"Where does spruce grow in Wisconsin?"

Growing stock volume by region with map



The vast majority of white and black spruce (92%) occurs in northern Wisconsin (Table 1). White spruce is found on a variety of soil and moisture conditions whereas black spruce occurs predominately in wet, low-nutrient soils.

Most spruce is found on the spruce fir forest type but in central and northern Wisconsin, about one quarter is found on the aspen birch type.

Table 1. Growing stock volume (million cft) by species and region of the state.

Species	Central	North east	North west	South east	South west	Total	Percent of total
Black Spruce	3	113	75	0	-	191	**43%**
White Spruce	14	109	112	11	10	255	**57%**
Total spruce	17	222	187	11	10	447	**100%**
Percent of total	**4%**	**50%**	**42%**	**2%**	**2%**	**100%**	

Source: USDA Forest Service, Forest Inventory and Analysis 2008 data

Additional tables:

Volume by county in 2008 (pdf; Excel)

"How fast is spruce growing?"

Average annual net growth by region and year

Average annual net growth of spruce is about 12 million cft/yr, representing 2% of statewide volume growth (Chart 4). Growth rates have decreased 26% since 1983 but remained statistically unchanged since 1996.

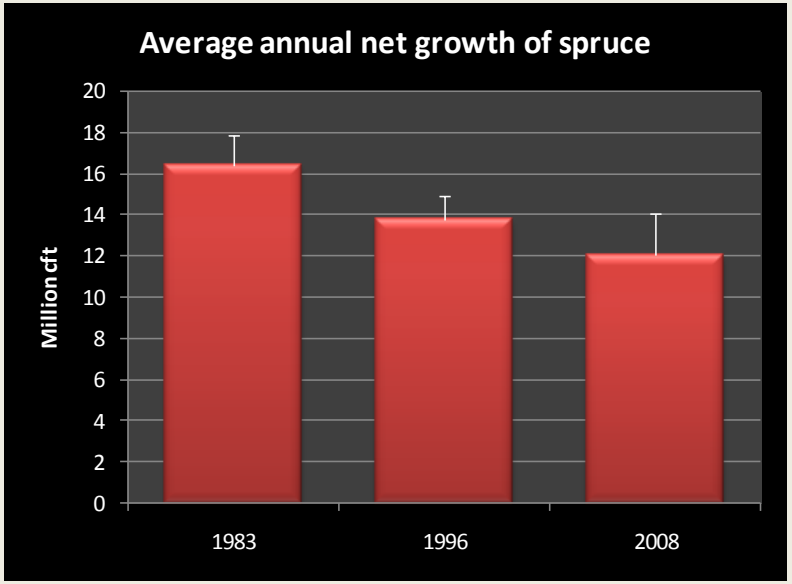


Chart 4. Average annual net growth (million cubic feet).
Source: USDA Forest Inventory & Analysis data: 1983, 1996, 2008

Table 2. Average annual net growth (million cft/year) of growing stock and the ratio of growth to volume by region of the state.

Region	Net growth	Percent of Total	Ratio of growth to volume
Central	0.9	8%	**5.4%**
Northeast	6.3	52%	**2.8%**
Northwest	3.5	29%	**1.9%**
Southeast	0.7	6%	**6.8%**
Southwest	0.6	5%	**6.2%**
Statewide	**12.1**	**100%**	**2.7%**

Source: USDA Forest Inventory and Analysis 2008

The highest volume growth for spruce occurs in northern Wisconsin where most spruce is found, but the highest growth to volume ratio occurs in the southern part of the state (Table 2).

The average statewide ratio for spruce is 2.7%, slightly lower than the statewide average of 2.8% for all species.

Additional tables:
Average annual growth, mortality and removals by region (Pdf, Excel).

"How healthy is spruce in Wisconsin?"

Average annual mortality: 1983, 1996, and 2008

Average annual mortality of spruce, about 5.6 million cft per year in 2008, or about 3% of total statewide mortality (Chart 5). Mortality has tripled since 1983 but remained statistically unchanged since 1996.

The ratio of mortality to gross growth is 29% for spruce, **higher than the statewide average** of 26% (Table 3). Black spruce has a very high ratio of mortality to gross growth. Forty percent of new growth is lost to mortality.

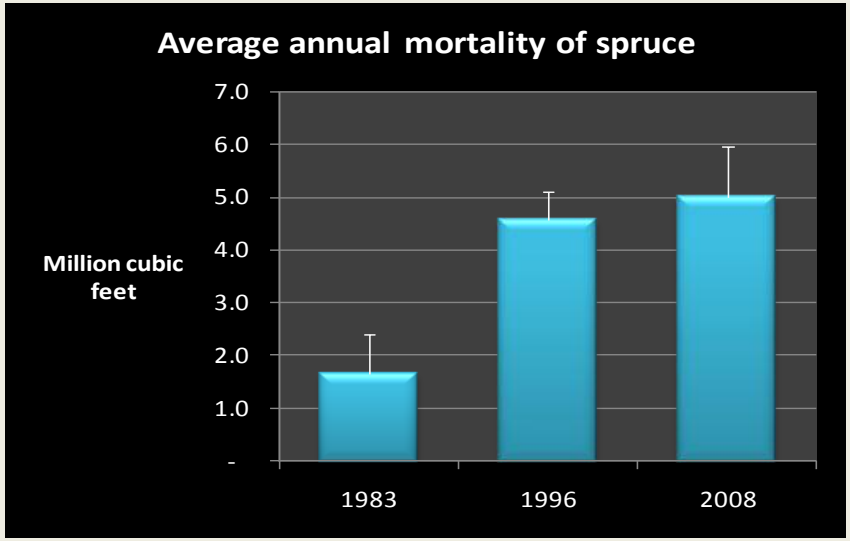


Chart 5. Average annual mortality (million cubic feet) by inventory year.
Source: USDA Forest Inventory & Analysis data: 1983, 1996, and 2008

Table 3. Mortality, gross growth (excluding mortality) and the ratio of mortality to gross growth.

Species	Average annual mortality (cft)	Average annual gross growth (cft)	Mortality / growth
Black Spruce	2,546,693	6,187,470	**41%**
White Spruce	2,442,856	10,862,542	**22%**
Total Spruce	**4,989,549**	**17,050,012**	**29%**

Source: USDA Forest Inventory and Analysis 2008

Additional tables:
Average annual growth, mortality and removals by region (Pdf, Excel).

"How much spruce do we harvest?"

Roundwood production by product and year: 1997, 2002 and 2007

In 2003, spruce accounted for 6.2 million cft or about 1.5% of Wisconsin's total roundwood, more than ¾ for pulpwood (Chart 6).

In 2006, pulpwood production increased by 2 million cft or 44% since 2003. Spruce supplies 7 million cft or 5% of total pulpwood production.

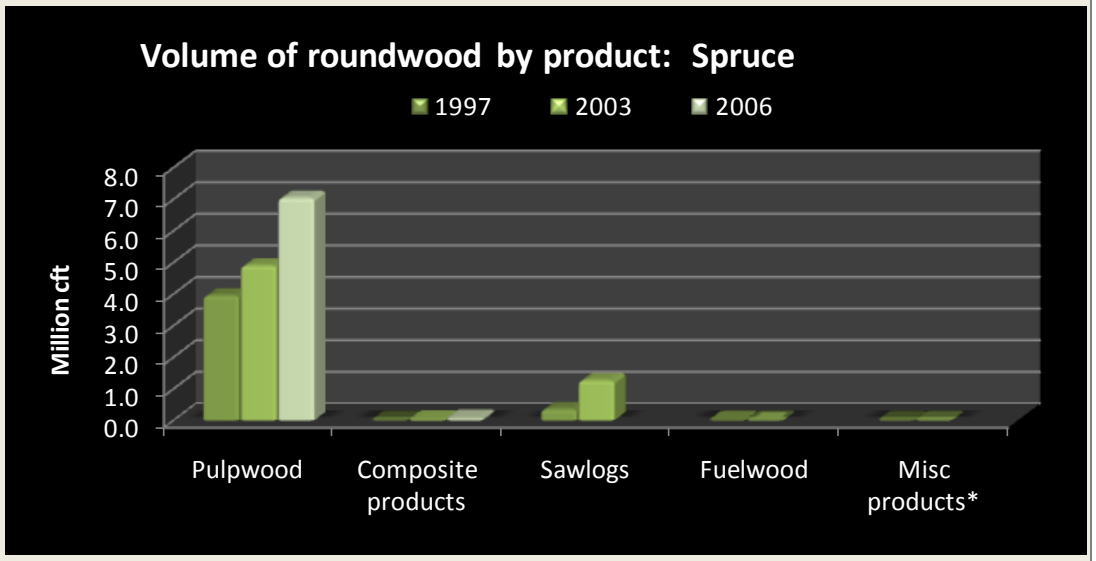


Chart 6. Volume of roundwood products. The most recent numbers for pulpwood and composite products are from 2006 and the most recent numbers for sawlogs, fuelwood and miscellaneous products are from 2003 (Ron Piva).
* Miscellaneous products include poles, posts, pilings and veneer.
Source: Timber Products Output Mapmaker, http://ncrs2.fs.fed.us/4801/fiadb/rpa_tpo/wc_rpa_tpo.ASP

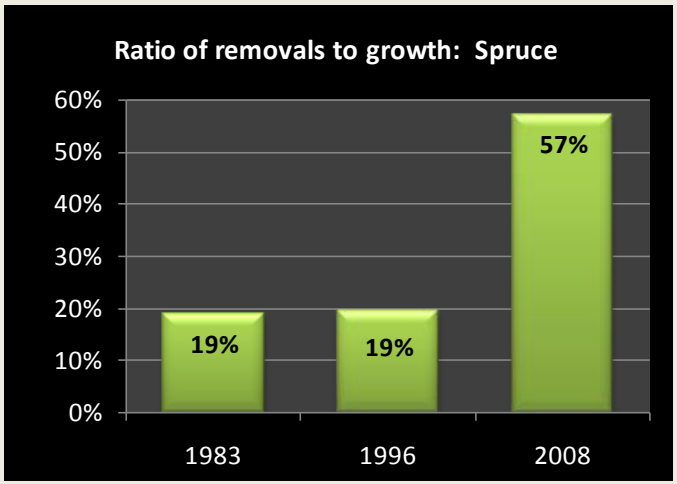


Chart 7. Ratio of volume harvested annually to net growth.
Source: USDA Forest Inventory & Analysis data: 1983, 1996, and 2008.

The ratio of removals to growth for spruce is 57%, equal to the average of 56% for all species in the state (Chart 7).

Additional tables:
Average annual growth, mortality and removals by region (Pdf, Excel).

"How much is spruce selling for?"

Prices for cordwood & sawtimber: 2000 to present

Due to the variability of timber prices from region to region, the prices reported here are the average weighted average stumpage prices from Wisconsin Administrative Code Chapter NR46.

Stumpage prices for spruce have decreased for the last 2-3 years but still remain above average.

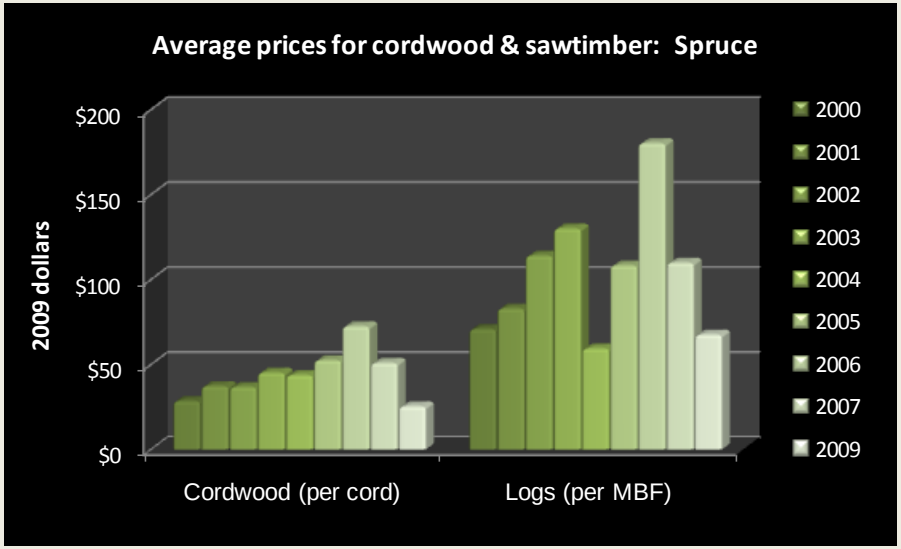


Chart 8. Average prices for cordwood and sawtimber (2000-2009).
Source: Wisconsin Administrative Code Chapter NR46 (2000-2009)

Table 4. Average weighted stumpage prices (adjusted for inflation to 2009 dollar) by year for Wisconsin.

Product	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Average for all softwoods
Cordwood (per cord)	$29	$37	$37	$45	$44	$53	$73	$51	$26	**$25**	$23
Sawlogs (per MBF)	$71	$83	$114	$130	$59	$108	$180	$110	$82	**$68**	$76

Source: Wisconsin Administrative Code Chapter NR46, 2000 to 2009

"How much spruce biomass do we have?"

Oven-dry tons by region of the state

There were 10.3 million oven-dry tons of spruce biomass in 2008, an increase of 500,000 ODT or 5%, from 1996. This species represents only 1.7% of all live biomass statewide. As with volume, most spruce biomass is located in northern Wisconsin (Chart 9).

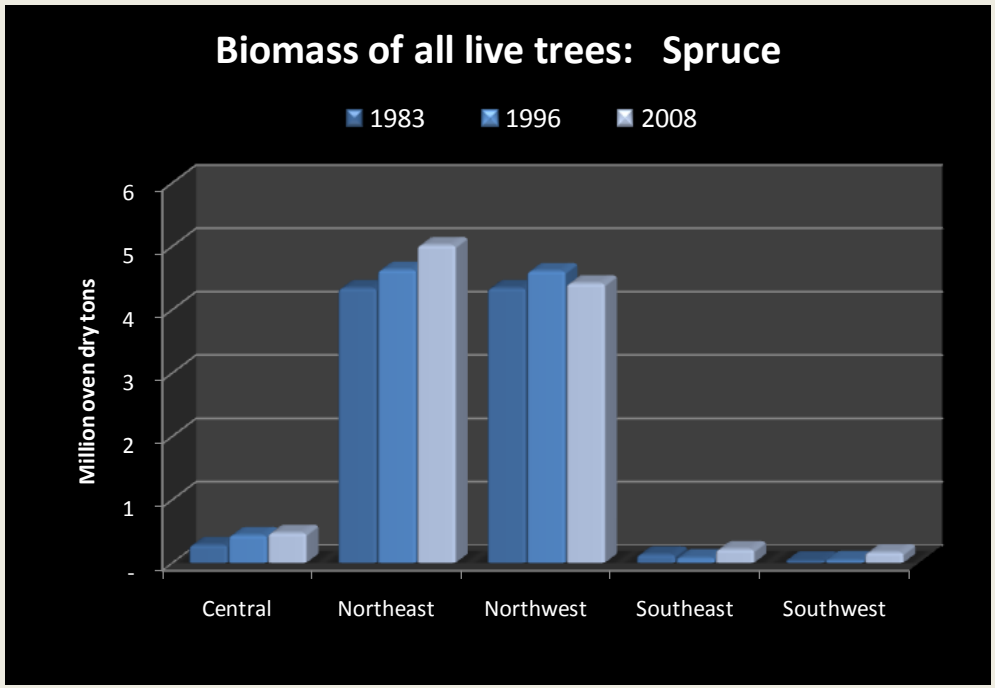


Chart 9. Biomass (million oven-dry tons) by year and region.
Source: USDA Forest Inventory & Analysis data: 1983, 1996, and 2008

The density of spruce wood is slightly lower than average for softwoods with a ratio of biomass to volume of 33.8 oven-dry lbs. per cubic foot (ODP/cft). The average for all softwoods is about 34.3 ODP/cft and for all species is 46.8 ODP/cft.

Approximately, 80% of all spruce biomass is located in the main stem and 14% in the branches.

Additional tables:
Biomass by county in 2008 (pdf; Excel)